The Basic Principles of Collapse Therapy

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SUMMARY

Collapse therapy has a definite objective of resting and healing tuberculous lesions. It should be used, not so much as an independent means, but as a supplement to other established practices in the treatment of tuberculosis.

The indications for each measure have changed over the years and are still changing, so that proper treatment can be given only by those having a knowledge of the changing trends, as well as of the disease and principles of treatment. Each case should be handled on its merits and the choice of procedure should depend generally upon the circumstances, such as the skill of the physician carrying it out, the facilities for the care of the patient, and the equipment for working. Above all, it should be recognized that knowledge, experience, and especially wisdom will go far towards achieving good results.

THE sole aim of collapse therapy is to heal tuberculous lesions by rest. This trite pronouncement may seem overly simple, yet in the past, and even at present, neglect of the important principles and precautions has brought much discredit on some forms of collapse therapy in the treatment of tuberculosis. The purpose of mentioning these facts is first of all to prevent beginners from falling into error; to improve results by a better selection of cases; and to rescue certain methods from possible disrepute.

During the last few decades many new procedures have been introduced, yet there is not one of the old established methods that can be neglected. Rest of an active disease process—the first principle of medicine — was first applied in tuberculosis by Bremher, Detweiller, Trudeau and others. Bodily rest was first applied and later other accessory forms of rest, such as collapse therapy, were added. All are agreed that collapse therapy must be applied; the chief differences of opinion concern the emphasis to be placed on different methods. Each has had its enthusiastic advocates who have been prone to show their particular procedure to advantage, especially during the first stages of experimentation. However, we should not be too hasty in condemnation of anybody, because when an experimenter works for a long time on a particular method, he becomes more proficient in its techniques than those who use it rarely. If we follow the old Indian proverb, we will hesitate to judge any man until we have walked for two moons in his moccasins. Final results form the ultimate criteria for judgment.

Before considering specific methods, it may be well to mention the basic prerequisites to any successful treatment: Total rest, proper diet, warmth, proper "environment" (in the meaning of the word as originally expressed by Krause[2] in his admirable booklet), and finally, the psychological "conditioning" of the patient.

Neglect of the principle of total rest (during the early course of the treatment) is the main reason for so many failures in collapse therapy.

Perhaps the first task to be accomplished after a diagnosis has been made is the psychological indoctrination of the patient. His mind must be brought under control and put in tune with what is to follow. Without such precautions, the work of many months may come to naught.

Patients must be persuaded to give up all their ambitions and plans and do precisely what they are told. The business must be taken over by someone else; the family must be managed by another; there must be no worries over the stock market, cattle on the range, girl or boy friends or any of the other factors of daily life that may increase the pulse or raise the blood pressure. It is not always necessary to talk tough—quite the contrary. The physician must gain the confidence of the patient by taking plenty of time to explain and to school him in what must be done.

The second requisite is to keep the patient's cooperation at the maximum. Every patient will have upsets and discouragements, especially early in treatment. These episodes must be met with patience and wisdom. Many times failure of treatment is due not so much to the "problem" patient as to the lack of preparation and lack of patience or understanding on the part of the physician.

As the next step, the whole physical make-up of the patient must be surveyed; complications must be sought out and treated. Proper diet and medication must be prescribed. Social tangles must be unsnarled. An intelligent social service can help in this work. A properly trained nurse must begin her duties of "taking over" the patient and explaining the role of the nurse in her relationship to him, as well as helping to orient him in the new life. After these many preliminaries are finished and the patient studied for a period ranging from 30 to 90 days, collapse therapy and other methods may be considered and applied as required.

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Collapse therapy is of two radically different types, the temporary and the permanent; and each has its particular advantages and drawbacks. The types of temporary collapse—phrenic nerve crushing, extrapleural and intrapleural collapse with air, oil, or other medium—have the advantage of reversibility. Permanent collapse — thoracoplasty, complete extraction of the phrenic nerve, etc.—usually involves a tendency toward total healing with permanent loss of function of the collapsed part of the organ. The stages of healing are, in most permanent operations, more certain and rapid than those described for the temporarily collapsed lung.

In order to clarify indications, it is well to review the basic principles involved, more especially with regard to temporary collapse.

The first result of lung collapse is immobilization of the organ and its contents. The tuberculous lesions are made more compact, the cellular barrier becomes more impermeable, and both bacillary and toxic elements are better confined.

The great unknown in tuberculosis is the interplay of dosage and virulence of the particular strain of bacilli with a number of variable factors such as age, sex, race and that thing sometimes called resistance. A proper combination of favorable factors in the patient may lead to rapid cure; with unfavorable factors uppermost the outcome may be fatal.

In the disease process the spread and increase in numbers of bacilli are counteracted by infiltration and phagocytic action of outside cellular elements and by action of cells and tissues *in situ*. When the increase of bacilli is more rapid than the destruction of them by phagocytes, or when the cellular barrier does not stop the spread of the bacilli, the disease continues to be progressive. The progress around the margins of the lesions is of greatest significance. The center of the tubercle may be a miniature caldron of toxic material, but unless an opening is made in the margin, or into one of the vascular or bronchial canal systems, no extension of the disease can occur. The margin, therefore, is the battle line where the principal ebb-and-flow of the disease takes place. If the spread is not overwhelming, a capsule soon begins to form, resorption of perifocal exudate takes place and healing gets under way.

Collapse therapy facilitates this healing process; in complete collapse there is absolute cessation of tissue mobility and effective containment of bacilli and their toxins. Complete collapse in pneumothorax, however, is fraught with many dangers, particularly effusion, infection and empyema. The Ascoli method of "hypotensive" or selective collapse is usually practiced. With this method there is only a partial collapse of the lung, but the diseased area contracts more in proportion than the surrounding normal lung. Local atelectasis develops which, with skill, may be controlled until good healing occurs. Great skill is required in the timing of instillations and in controlling the degree of collapse.

Along with the contraction of tubercles and infiltrates is the greatest of all effects produced by collapse therapy—a compression of cavities. Sometimes it requires weeks for a cavity to close, even with collapse therapy, although there is always a relative decrease in the amounts of sputum and bacilli eliminated. If closure is not effected after a reasonable trial, or after adhesions have been cut, the temporary collapse therapy should be abandoned and permanent collapse resorted to.

Collapse does another thing almost as important as those just mentioned: It slows both blood and lymph circulation. Carvalho,[1] Steinberg[3] and others have shown by angiopneumography that the blood circulation is cut down in proportion with the degree of collapse of the lung. This change in circulation, first, reduces absorption of toxins into the system and, second, cuts down on nourishment to the bacilli. Since tubercle bacilli may survive for long periods in immobilized tissue, the immediate effect is to reduce absorption of toxic elements, including tuberculin, which is reflected in a proportional reduction of constitutional symptoms.

Perhaps another factor which arises in this alteration of the physiologic state should be mentioned—the reduction in tissue metabolism which would reduce the catabolites and thus remove some drawbacks to healing.

After the acute phase of collapse has been stabilized, the second phase begins—the process of encapsulation of lesions and resorption of certain elements within the tubercle. In reality this is a continuous process, for encapsulation begins very early and, as the spread of the disease is controlled, more and more fibers form in the outer wall of the lesion until a true capsule results. Only occasionally does spread occur once this stage is reached. In the majority of cases, completion of the healing process ensues—destruction of the bacilli and resorption of the residual toxins, of removable caseous material and even of calcareous material. During this period the properly closed cavity will fill in with fibroblasts and capillaries, leaving behind a relatively small stellate scar at the site of the cavity.

The final process is reexpansion with the restoration and restitution of tissue. The ultimate restoration of function depends upon the extent of direct destruction of tissue by ulceration, the amount of caseous material that becomes encapsulated, the injury to cells by toxins, and the distortion of tissues by fibrous contraction. Most of these effects are self-evident. The toxic effect on cells, however, has far more significance than is ordinarily appreciated. Any tuberculous process, no matter how mild, leaves a blighting effect on all the cells in the vicinity. This is a fundamental difference between tuberculosis and most other lung diseases. Even a mild gelatinous exudate with greatly diluted toxins will singe the cells, weaken the elastic tissue and result in varying degrees of emphysema. This may be called the "emphysema of healing," because it is always present in a healed tuberculous process. The extent of emphysema may be of any degree from zero to a total loss of function.

The final changes involve the slow resorption of caseation, calcification and even of fibroid tissue. In this process of fibrosis and resorption, the contraction of fibrous tissue results in many distortions which may interfere with function. Noteworthy in this respect is the constriction of bronchi leading to obstruction or partial obstruction, obliterative pleuritis, a buckling of bronchi, deviation of trachea, and sometimes a constriction of the great vessels, especially the vena cava and pulmonary arteries and veins.

There are almost as many physiologic as anatomic changes. Besides the slowing of circulation already mentioned, there is a reduction of toxins which reduces the objective clinical symptoms; an increase in collapse which reduces the vital capacity, minute volume, ventilatory capacity and all vital pulmonary functions. The distortion of bronchi and vessels, and especially the emphysema lead to a reduction of pulmonary function which sometimes is manifested by permanent dyspnea. As recovery approaches, most patients regain enough function to carry on in a new vocation properly selected in an intelligent rehabilitation program.

As to permanent collapse, the process is sudden and total. The lung should be completely compressed. The bacilli are entrapped and suddenly smothered. Healing proceeds more swiftly and is more certain. Occasionally a thick-walled cavity is not closed, and in that event revised collapse procedure or resection is carried out.

A word of caution at this point: It should be remembered that many tuberculous processes extend to the lymph nodes beyond the lungs and to other organs, so that often extrapulmonary disease must be dealt with concurrently. In these circumstances only rest and lung therapy offer any hope.

After this survey of principles, it becomes a problem to decide upon the most desirable method of treatment. The choice depends upon two main factors: The nature of the case in question, and the particular experience of the physician who is to carry out the treatment. The choice should be governed by the maximum results possible in the shortest time and with the least inconvenience to the patient. Factors that must be considered are the character, extent and location of the lesion, duration of the process, size and position of cavities, if any, and the presence of associated lesions, especially enteritis, pleuritis, laryngitis, bronchitis and, particularly, bronchial obstruction.

As to choice on the basis of the particular experience of the physician conducting therapy, it must be recognized that whereas the majority of cases fall automatically into certain categories, there are perhaps 30 per cent in which no hard and fast rules may be applied. In such cases a justifiable difference of opinion may exist, and the method of collapse used may depend largely on the background and training of the therapist.

Furthermore, new phases of treatment have appeared, viz: Chemotherapy and excisional operation. In many cases simple drug therapy, or excision, or both, may be more suitable than collapse therapy. In other cases these methods of treatment may be advantageously combined with collapse, and in such cases the collapse measures are applied as they have always been. These important additions to the magazine of therapy have of course greatly altered the indications for collapse therapy.

Since different methods may arrive at the same result, it may help to illustrate the process of choice with example. Take, for example, decision between pneumothorax and upper stage thoracoplasty. Assuming that the indications are ideal for pneumothorax (small cavity, deep in the upper lobe, no complications, etc.) probably the majority of therapists would employ that method of treatment and risk the later hazards of fluid accumulation, empyema, adhesions, etc., to carry it out over a three to five year period. Of all possible operative procedures, it should be considered first. It has been used with success in thousands of cases. Most of the bad results have not been the fault of the method, but of the way it was carried out.

If pneumothorax is decided upon, the patient must be told that hospitalization and complete rest are necessary during the early stages of treatment. Even later, dissipation of any sort, including smoking and excessive drinking, is tabu. The patient must keep free from worry and must eat well. He must always keep warm and avoid chilling. If he contracts an infection, he must go to bed and call the physician. The physician must follow the patient closely so that no complications are permitted to develop.

The dangers inherent in the procedure should not be underestimated. With sound training, however, the hazards of well carried out pneumothorax should be slight.

On the other hand, upper stage thoracoplasty will often do just as much and do it in a shorter time. After a few months, the patient is permanently cured. Refills are not necessary, there is no danger of accumulation of fluid, and disciplinary problems are fewer, although bed rest must be continued until all constitutional symptoms are gone. A disadvantage of the operation is the scar, which to some patients is objectionable. Another important drawback is that the method requires more equipment, special skill and better facilities. Perhaps the greatest objection to the operation is that there is always much good lung tissue permanently sacrificed. Later in life this small segment of lung may be the difference between survival and progressive cor pulmonale.

In choosing the method of treatment it may also be necessary to consider phrenic nerve crush with or without pneumoperitoneum. There is little doubt that the first wave of phrenic operation stirred unjustifiable enthusiasm for its use—so much so that one great surgeon questioned whether it might not be "a crime wave."

The phrenic operation, however, is used in many clinics with tremendous success. There is no doubt

that it does much more than relax the diaphragm and the lower lobe. It relaxes the whole lung, all the way to the apex. The result is almost the same as that of hypotensive pneumothorax, except that the lung is relaxed vertically more than horizontally. Furthermore, the effect lasts from three to six months and there is no danger of accumulation of fluids.

When phrenic crushing is used with pneumoperitoneum and drug therapy, the result is in some cases better than that obtained with pneumothorax. Perhaps one of the most significant changes over the last five years has been the increase in the use of pneumoperitoneum (with or without phrenic crushing and drugs) and a corresponding decrease in the use of pneumothorax. Pneumoperitoneum has not yet become universally appreciated, but the use of pneumothorax has decreased. A decade ago it was used in 30 to 40 per cent of cases in many hospitals; now in about 20 per cent of all cases.

Although the whole basis of treatment is changing rapidly, methods and factors in therapy that are known to be sound should not be lost to view. The principle of rest still is applicable wherever and whenever it is indicated. It should be applied to the maximum where the indications are sharp, and supported to the limit with every means available.

There are certain abuses that cannot be condoned. Perhaps the most common in the past has been neglect of proper indoctrination of the patient as to the disease and the need for rest. This has been due to several things. All too many physicians have lost sight of the need for the application of rest, *in addition to any other treatment.* That statement applies, in addition to collapse measures, more especially to surgical procedures and recent drug therapy. All too many patients are given pneumothorax or phrenic nerve crush and then allowed to go home for a "few days' rest before going back to work," after which they come in for refills or obtain refills from a "panel" doctor in a clinic. Such treatment cannot be condemned too severely. Of course some patients would get well in spite of the poor method—30 per cent get well without any treatment—but a large percentage are lost. The patient also obtains a false sense of security that is dangerous. He is not given the proper meaning of the treatment. A large percentage of such patients develop adhesions, fluid accumulation and spread of disease to other parts of the lungs. Then they are saved, if at all, only by years of treatment or radical operation.

So-called ambulant pneumothorax, therefore, can be a total failure if not properly supervised, yet in all pneumothorax the patient is ambulant at certain stages of the treatment. It is a matter of selection and timing, as was mentioned previously. Each patient must be followed closely. If acute infection develops, it must be treated promptly. The early use of penicillin to ward off a throat infection, bronchitis or pleuritis is justified for such patients. Particularly should pleurisy with effusion be avoided, because infections frequently lead to empyema.

It is not my wish to condemn office or clinic practice of pneumothorax, certainly not as an emergency measure or where there are no available beds. If it is employed as emergency treatment, good supervision can avoid all but a few complications, and if it is done in the office or clinic because of bed shortage, it is defensible as a makeshift to do the best possible.

Orrego's work in Santiago, Chile, where there was only one bed per ten deaths, is impressive. This resourceful physician instituted substations with temporary beds where patients could be housed for a few days after treatment until the acute symptoms wore off. Then other patients would take their places. By staggering the use of beds, the maximum results were obtained in a most unfavorable situation. The greatest danger in such a method is that the practice might become a permanent one and vitiate attempts to obtain better facilities when they can be obtained.

After the patient's condition has become stabilized, ambulant collapse therapy *may* be instituted. With intelligent application of principles and proper guidance of the patient as indicated before, the dangerous complications can be reduced to a minimum and the patient brought to a successful cure.

Each of the many other surgical collapse measures could be dealt with in the light of the basic principle expressed, but enough has been given to afford a rough pattern to follow. It is well to remember that basic knowledge is the foundation and that proper judgment of all factors is the superstructure of any treatment program.

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